**SECTION 7 SPECIAL ELECTRICAL INSTALLATIONS**

**7.1 GENERAL**

**7.1.1 Application**

This Section specifies the minimum requirements for the selection and installation of electrical equipment in special electrical installations, which shall be achieved to satisfy Part 1 of this Standard.

**7.1.2 Selection and Installation**

The particular requirements for each special electrical installation replace or modify the general requirements of the other Sections of this standard. Where this Section does not specify a requirement, the relevant requirements of other Sections of this Standard apply.

This Section applies to the following special electrical installations: (a) Electrical systems for safety services. (b) Electricity generation systems. (c) Protection by electrical separation. (d) Extra-low voltage electrical installations. (e) High voltage electrical installations. (f) Installations in areas where an explosive hazard may arise. (g) Electrical installations of: (i) construction and demolition sites; (ii) electromedical treatment areas; (iii) transportable structures and vehicles and the sites from which they are supplied; (iv) marinas and recreational boats; (v) shows and carnivals; (vi) cold cathode illumination systems; (vii) telecommunication networks power supplies; (viii) cranes and hoists; (ix) lifts; (x) generating sets; (xi) outdoor sites under heavy conditions; (xii) electric fences; and (xiii) film, video, and television sites.

**7.2 SAFETY SERVICES**

**7.2.1 Scope and General**

**7.2.1.1 Scope**

The particular requirements of this Clause (Clause 7.2) apply to the electrical installation of building services that are essential for the safe operation of safety services consisting of fire detection, warning, and extinguishing systems, smoke control systems, evacuation systems, and the safety of persons using lifts.

**7.2.1.2 General**

These requirements are intended to ensure that electricity supply is not inadvertently disconnected from electrical equipment that is required to operate during emergency conditions.

**Exceptions:** The following need not comply with Clause 7.2:

1. Escalators or moving walkways (travelators).
2. A lift in a single private residence that is installed in accordance with AS/NZS 1735.18 need not comply with the requirements of this Clause (Clause 7.2).
3. Lifts that are not defined as emergency lifts in the National Construction Code (NCC) or New Zealand Building Code (NZBC).
4. Pumps for 'jacking' or water pressure maintenance, the failure of which does not deprive the fire hydrant or sprinkler pump of adequate water supply.
5. **Text deleted.**
6. Smoke alarms installed in single private residences (see Clause 4.6 for information relating to smoke alarms).

**NOTES:**

1. AS/NZS 3009 provides guidance for emergency power supplies in hospitals.
2. The term 'safety services' incorporates equipment: (a) described, and which could be labelled, as 'emergency systems' under the previous edition of this Standard; and (b) determined as 'emergency equipment' in the NCC and 'essential service' in the NZBC.
3. Fire-resistance level (FRL) is the grading periods in minutes determined in accordance with NCC for the following criteria: (i) **Structural adequacy** - 1st 120 = FRL-structural adequacy: The ability to maintain stability and adequate load-bearing capacity as determined by AS 1530.4. (ii) **Integrity** - 2nd 120 = FRL-structural integrity: The ability to resist the passage of flames and hot gases as specified by AS 1530.4. (iii) **Insulation** - 3rd 120 = FRL-structural insulation: The ability to maintain a temperature over the whole of the unexposed surface below that specified by AS 1530.4.

**7.2.2 Supply Systems**

**7.2.2.1 General**

Wiring systems associated with safety services shall be capable of maintaining supply to electrical equipment when exposed to fire. An electrical source for safety services shall not be used for purposes other than safety services unless the supply availability for safety services is not impaired.

When safety services are required to operate under emergency conditions or there is a loss of normal supply, it may be necessary to automatically disconnect supply from other non-essential equipment to provide sufficient capacity for the safety services.

**Exception:** This Clause does not apply to fire detection, alarm, and intercom systems with battery backup complying with AS 1670 or NZS 4512.

**7.2.2.2 Wiring Systems (Mains, Submains, Main Switchboard, and Supplies to Outbuildings)**

**7.2.2.2.1 WS Classification Provided**

Wiring systems, including their supports, supplying safety services consisting of: (a) consumer mains; (b) generator supplies; (c) normal supplies; (d) alternate supplies; and (e) supplies to outbuildings, and fire-isolated portions of buildings,

shall comply with AS/NZS 3013, with a WS classification as specified by the Standard relevant to the installation of such equipment.

**NOTE:** See Appendix H for further information regarding the application of the WS classification system.

**7.2.2.2.2 WS Classification Not Provided**

Where the relevant Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and protected against mechanical damage by: (i) installation in a suitable enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

Conductors supplying safety services shall: (A) be physically separated from all other wiring systems by at least 50 mm horizontally or by suitable barriers [see Clause 3.9.8.1, Items (d) and (e)]; and (B) be separated from all other safety services by at least 50 mm horizontally or by suitable barriers.

Conductors of different safety services shall not: (1) be incorporated with each other within a multi-core cable; or (2) with conductors of any other wiring system within a multi-core cable.

Where any WS cabling traverses environments that dictate different mechanical protection requirements, and it is neither viable nor practicable to change the degree of protection at the transition points, the installed cabling shall comply with the highest requirement of protection.

**Exceptions:** The fire protection requirements of mains, submains, and supplies to outbuildings need not apply to the following:

1. Wiring systems installed in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Cables or enclosed wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in appropriate fire-rated enclosures and provided with suitable mechanical protection.
2. Wiring systems installed that provide the primary power source for emergency warning systems, fire detection, and alarm systems that are provided with battery backup in accordance with the AS 1670 series or NZS 4512, up to the control and indicating panel.
3. Wiring systems installed for electric-driven fire pumps that form part of a pump set that includes a standby fuel-driven pump.
4. Wiring systems installed for supplying battery chargers for battery-operated single-point lighting systems that are provided for emergency evacuation purposes.

**7.2.2.3 Alternative Supply Systems**

**7.2.2.3.1 Continued Occupation**

Where an alternative supply is provided for the continued safe occupation of the building, the following requirements apply: (a) **Safety services:** The alternative supply system shall have sufficient capacity to operate all safety services. (b) **Continued occupation of any portion of the building (during loss of normal supply):** The alternative supply system shall have sufficient capacity to supply electrical equipment associated with the continued occupation of the building.

Generating sets and other independent sources of supply shall have sufficient capacity to supply all the safety services simultaneously. Allowance is required for motor start-up by plant sequencing or additional capacity for motor starting.

A dedicated alternative supply may be provided for electrical equipment other than (a) and (b).

**NOTE:** Examples may be for security purposes or preservation of business assets and stock, e.g., refrigeration.

**7.2.2.3.2 Fire Management System**

Where a fire management system is incorporated, the fire management system controlling the nominated safety services shall be connected to the alternative supply and the alternative supply shall have sufficient capacity to supply all the nominated safety services required to operate in fire mode. There shall be allowance for motor start-up by plant sequencing or additional capacity for motor starting.

**7.2.3 Main Switchboard and Switchgear**

**7.2.3.1 General**

A safety service shall be controlled by a main switch that is separate from main switches used to control: (a) any part of the general electrical installation; and (b) other types of safety services.

Main switchboards shall be installed in accordance with Clause 2.10 and the National Construction Code or the New Zealand Building Code.

**NOTE:** Typical examples of main switchboards with one and two normal supplies are shown in Figures 7.2(A) and 7.2(B) respectively.

**7.2.3.2 Switchgear**

Where safety services are installed, all switchboards that are required to sustain supply to safety services shall be constructed so that the safety services switchgear is separated from general switchgear by metal partitions designed to minimize the spread of a fault from the general switchgear to the safety services switchgear.

**NOTE:** A non-metallic case switchboard does not comply with this Clause.

**7.2.3.3 Cables in the Same Enclosure**

Conductors of safety services shall not be enclosed with conductors of different safety services or with conductors of any other system.

For the purposes of this clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems complying with Clause 7.2.2.2 may be considered to provide effective segregation. (c) Wiring systems within switchboards shall be separated from all other wiring systems by at least 50 mm or by effective barriers.

**7.2.3.4 Arrangement**

Where a supply isolating device is installed, it shall be a load break switch or circuit-breaker. Discrimination (selectivity) shall be achieved between all protective devices if the supply isolating device is a circuit-breaker.

**NOTE:** Some jurisdictions may have additional requirements for the isolating device, such as: (a) capable of being locked on; and (b) labelled for operation by authorized personnel only.

**7.2.3.5 Discrimination (Selectivity) of Circuit-Protective Devices**

Protective devices shall be selected such that: (a) a fault on one safety service will not result in loss of supply to other safety services; and (b) a fault on the general electrical installation will not result in loss of supply to safety services.

Fault-current limiters used to protect safety services shall not be used to provide protection to any part of the general electrical installation. Discrimination shall be arranged between protective devices for outgoing circuits and the upstream protective device. Refer to Clause 2.5.7.2.3.

**7.2.4 Main Switches**

**7.2.4.1 General**

A safety service shall be controlled by a main switch that is separate from main switches used to control: (a) any part of the general electrical installation; and (b) other types of safety services.

Main switches shall be selected such that: (i) a fault on one safety service will not result in loss of supply to other safety services; and (ii) a fault on the general electrical installation will not result in loss of supply to safety services.

There is no limit to the number of main switches installed for the control of safety services. An auto transfer switch (ATS) may be used as a main switch provided the ATS meets the requirements of Clause 2.3.3. Fault-current limiters used to protect safety services shall not be used to provide protection to any part of the general electrical installation.

**7.2.4.2 Arrangement of Main Switches**

Main switches for safety services shall: (a) be connected on the supply side of all general electrical installation main switches; (b) not be subject to the control of any general electrical installation main switch; and (c) control only electrical equipment that is regarded as safety services.

**Exception:** This requirement need not apply to the following:

1. A high voltage switch, controlling the supply to a low voltage switchboard that is not regarded as a general electrical installation main switch.
2. A low voltage switch capable of operation only by authorized persons and marked accordingly. Locking-on of a switch is regarded as a means of ensuring that it is subject to operation only by authorized persons.
3. Safety services that are installed in an individual outbuilding, combined outbuilding, or a fire-separated portion of a building, in accordance with Clauses 7.2.4.5 and 7.2.4.6.
4. Automatic fire detection, alarm, and intercom systems or sound and intercom systems for emergency purposes that are:

* supplied from the supply side of a distribution board not more than one distribution board removed from the main switchboard; and
* marked in accordance with Clause 7.2.4.4; and
* provided with a secondary power source, in accordance with the AS 1670 series or NZS 4512.

**7.2.4.3 Mechanical Protection**

Switches and control equipment that are part of a safety service installation shall be adequately protected if they may be subject to mechanical damage because of their location or condition of use.

**7.2.4.4 Identification**

All switches operating in the supply circuit to safety services shall be clearly identified to indicate the safety service they control.

Main switches controlling safety services shall be: (a) identified as 'MAIN SWITCH' and indicate the safety service equipment they control (in uppercase); (b) marked 'IN THE EVENT OF FIRE DO NOT SWITCH OFF' (in uppercase); and (c) identified by contrasting coloring or other suitable means, in accordance with Clause 2.3.3.4.

**7.2.4.5 Electrical Installations in Outbuildings**

A switch for safety services that is installed on the switchboard in an outbuilding shall be regarded as a main switch, in accordance with Clause 7.2.4. A safety service main switch installed in an outbuilding shall be clearly identified in accordance with Clause 7.2.4.4.

Any switch that: (a) is located remote from an outbuilding in which safety services are provided; and (b) operates in the supply circuit to a safety service main switch installed in the outbuilding, shall be clearly identified in accordance with Clause 7.2.4.4(b) and (c).

**7.2.4.6 Fire Separated Portions of a Building**

Any switch for the control of safety services installed in a fire-separated portion of a building and provided on the switchboard within the fire-separated portions of a building shall be regarded as a main switch and shall be arranged in accordance with Clause 7.2.4. Portions of a structure that are separated from any other part of the building by a fire-resistance level (FRL) of at least 120/120/120, in accordance with national building codes, may be regarded as a separate building for the purposes of this Clause.

Any switch installed for the control of safety services in a fire-separated portion of a building or structure that is regarded as a separate building shall be separate from switches used to control: (a) any part of the general electrical installation; and (b) other types of safety services.

**7.2.5 Fire Pumps and Fire Pump Control Equipment**

**7.2.5.1 General**

Fire pumps and fire pump control equipment shall include the following items and electrical equipment: (a) Fire hydrant booster pumps. (b) Pumps for automatic sprinkler systems, water spray or deluge systems, and similar fire extinguishing systems. (c) Pumps for fire-hose reels, where such hose reels form the sole means of fire protection, i.e., where fire hydrants and automatic fire-sprinkler systems are not installed. (d) Fire pump control equipment and wiring systems. (e) Fire pump rooms.

In addition to Items (a) to (e) above, there may exist other fire and smoke control equipment not listed.

**Exception:** The requirements of Clause 7.2 need not apply to electrical equipment, the failure of which does not affect the operation of safety services. Examples include but are not limited to the following: (a) Pumps for jacking and jockey pressure maintenance, the failure of which does not deprive the fire hydrant, sprinkler, or hose reel pump of adequate water supply. (b) Circuits of diesel-driven fire pump controllers arranged in accordance with the electrical requirements of AS 2941.

**NOTE:** Attention is drawn to the requirements for: (a) fire pumps in the AS 2118 series, AS 2419.1 and AS 2941 or NZS 4515, NZS 4517, and NZS 4541; and (b) automatic sprinkler systems in the AS 2118 series or NZS 4541.

**7.2.5.2 Wiring Systems Supplying Fire Pumps and Fire Pump Control Equipment**

**7.2.5.2.1 Types of Wiring Systems**

Wiring systems supplying fire pumps and fire pump control equipment shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment.

**NOTE:** See Appendix H for further information regarding the application of the WS classification system.

Where the relevant Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and protected against mechanical damage by: (i) installation in an effective enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

**Exception:** The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to the following:

1. Wiring systems in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Cables or enclosed wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in a fire-rated enclosure and provided with effective mechanical protection.
2. Wiring systems installed for electric-driven fire pumps that form part of a pump set that includes a stand-by fuel-driven pump.

**7.2.5.2.2 Segregation of Cables**

Conductors supplying fire pumps and fire pump control equipment shall not be enclosed with conductors of different safety services or with conductors of any other system. For the purposes of this Clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems complying with Clause 7.2.2.2 may be considered to provide effective segregation. (c) Wiring systems within switchboards shall be physically separated from all other wiring systems by at least 50 mm or by effective barriers. (d) Conductors of different safety services shall not be incorporated with each other within a multi-core cable or incorporated with conductors of any other wiring system within a multi-core cable.

**7.2.5.3 Switchgear for Fire Pumps and Fire Pump Control Equipment**

Where emergency equipment is required by national building codes, all switchboards that sustain supply to such equipment shall be constructed so that the emergency equipment switchgear is separated from other switchgear by metal partitions designed to minimize the spread of a fault from the other switchgear to the emergency switchgear.

**7.2.5.4 Interposing Switches for Fire Pumps and Fire Pump Control Equipment**

No switch shall be interposed between a main switch and downstream switchboards supplying fire pumps and fire pumps control equipment.

**7.2.5.5 Pump Rooms for Fire Pumps and Fire Pump Control Equipment**

In rooms used essentially to house fire hydrant or sprinkler pumps, lighting equipment and socket-outlets may be connected as a final subcircuit to the circuit supplying the pump equipment, provided that: (a) the final subcircuit is protected against any overcurrent, in accordance with Clause 2.5; (b) the final subcircuit is protected by an RCD with a fixed rated residual current not exceeding 30 mA; and (c) the wiring system between the pump equipment circuit and such final subcircuit protective device complies with: (i) the current-carrying capacity and installation requirements of Clause 2.5.3.1; and (ii) the type and segregation requirements of Clauses 7.2.5.2.2 and 7.2.5.3.

**Exception:** Circuits for lighting and socket-outlets in pump rooms installed in accordance with Clause 7.2.5.2.1. The wiring system between the final subcircuit protective device and the lighting equipment or socket-outlets need not comply with the requirements of Clause 7.2.5.2.2.

**7.2.5.6 Fire-Pump Motors**

**7.2.5.6.1 Isolating Switches for Fire-Pump Motors**

Where fire-pump motors are automatically controlled, a manually operated isolating switch shall be connected on the supply side of the pump motor. The isolating switch shall: (a) comply with the requirements of Clauses 2.3.2 and 2.3.6; and (b) be installed adjacent to the pump motor; and (c) be provided with a device for locking the switch in the closed position.

**7.2.5.6.2 Overcurrent Protection for Fire-Pump Motors**

The overload characteristics of overcurrent protective devices provided on circuits supplying fire-pump motors shall: (a) have an inverse time characteristic; and (b) be rated, or in the case of circuit-breakers be set to: (i) carry 125% of the full-load motor current continuously; and (ii) open the circuit in not less than 20 s at 600% of the full-load motor current.

No other overload protective device shall be inserted between the pump motor controller and the motor. Where more than one motor is provided on the same circuit, the overcurrent protective device may be rated or set to: (A) carry 125% of the sum of the full-load current of all motors operating simultaneously; and (B) open the circuit in not less than 20 s at 600% of the full-load current of the largest motor supplied.

**7.2.5.6.3 Overtemperature Protection for Fire-Pump Motors**

Overtemperature protective devices shall not be provided on fire-pump motors where the operation of such devices might reduce the operating time of the equipment under emergency conditions.

**7.2.5.6.4 Control Circuits for Fire-Pump Motors**

Control circuits associated with the operation of fire-pump motors shall: (a) be directly connected between the active and neutral conductor of the pump circuit; **NOTE:** This requirement precludes the use of transformers. (b) be arranged so that the active conductor of the control circuit is directly connected to the coil of the operating device within the starter; and (c) not be provided with overload protective devices other than those provided for the pump-motor circuit, in accordance with Clause 7.2.5.6.2. This arrangement requires the installation of a switch in the neutral conductor of the control circuit for a fire pump.

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**7.2.6 Fire and Smoke Detection Equipment and Fire Alarm Systems**

**7.2.6.1 General**

Fire and smoke detection and alarm systems shall include: (a) Fire and smoke detection equipment. (b) Fire indicator panels. (c) Fire and smoke alarm systems. (d) Warning and intercom systems.

**7.2.6.2 Wiring Systems for Fire Detection and Alarm Systems**

**7.2.6.2.1 Types of Wiring Systems for Fire Detection and Alarm Systems**

Wiring systems supplying fire detection and alarm systems shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment. **NOTE:** See Appendix H for further information regarding the application of the WS classification system.

Where the relevant Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and protected against mechanical damage by: (i) installation in an effective enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

**Exception:** The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to the following:

1. Wiring systems installed in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Cables or enclosed wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.
2. Circuits that provide the primary power source of fire detection and alarm systems that are provided with battery backup in accordance with the AS 1670 series or NZS 4512, up to the control and indicating panel.
3. Circuits of emergency warning systems complying with the AS 1670 series or NZS 4512, beyond the main equipment panel.

**7.2.6.2.2 Segregation of Cables for Fire Detection and Alarm Systems**

Conductors of fire detection and alarm systems shall not be enclosed with conductors of different safety services or with conductors of any other system. For the purposes of this Clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems for fire and smoke detection and fire alarm systems shall be physically separated from all other wiring systems by at least 50 mm or by effective barriers. (c) Conductors of different fire and smoke detection and fire alarm systems shall not be incorporated with each other within a multi-core cable or incorporated with conductors of any other wiring system within a multi-core cable.

**7.2.6.3 Interposing Switches for Fire Detection and Alarm Systems**

No switch shall be interposed between a main switch and downstream switchboards supplying fire and smoke detection and fire alarm systems.

**7.2.7 Air-Handling Systems**

**7.2.7.1 General**

Air-handling systems intended to exhaust and control the spread of fire and smoke are safety services.

**7.2.7.2 Wiring Systems for Air-Handling Systems**

**7.2.7.2.1 Types of Wiring System for Air-Handling Systems**

Wiring systems supplying air-handling systems shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment. **NOTE:** See Appendix H for further information regarding the application of the WS classification system.

Where the relevant Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and protected against mechanical damage by: (i) installation in an effective enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

**Exception:** The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to the following:

1. Wiring systems in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Cables or enclosed wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.

**7.2.7.2.2 Segregation of Cables for Air-Handling Systems**

Conductors supplying air-handling systems shall not be enclosed with different safety services or with conductors of any other system. For the purposes of this Clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems of air-handling systems shall be physically separated from all other wiring systems by at least 50 mm or by effective barriers. (c) Conductors of different safety services shall not be incorporated with each other within a multi-core cable or incorporated with conductors of any other wiring system within a multi-core cable.

**7.2.7.3 Interposing Switches for Air-Handling Systems**

No switch shall be interposed between a main switch and downstream switchboards supplying air-handling systems.

**7.2.8 Evacuation Equipment**

**7.2.8.1 General**

Evacuation equipment shall include sound systems and intercom systems for emergency purposes compliant with AS 1670.4. **NOTE:** Emergency evacuation lighting requirements are provided for in the National Construction Code or New Zealand Building Code.

**7.2.8.2 Wiring Systems for Evacuation Equipment**

**7.2.8.2.1 Types of Wiring System for Evacuation Equipment**

Wiring systems supplying evacuation equipment shall comply with AS/NZS 3013 with a WS classification as specified in AS 1670.4. **NOTE:** See Appendix H for further information regarding the application of the WS classification system.

**Exception:** The fire and mechanical protection requirements specified above need not apply to the following:

1. Wiring systems in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Cables or enclosed wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.
2. Supply to emergency warning systems that are provided with battery backup, in accordance with AS 1670.4 or NZS 4512, up to the main equipment panel.

**7.2.8.2.2 Segregation of Cables for Evacuation Equipment**

Conductors supplying evacuation equipment shall not be enclosed with different safety services or with conductors of any other system. For the purposes of this Clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems of evacuation equipment shall be physically separated from all other wiring systems by at least 50 mm or by effective barriers. (c) Conductors of different safety services shall not be incorporated with each other within a multi-core cable or be incorporated with conductors of any other wiring system within a multi-core cable.

**7.2.8.3 Interposing Switches for Evacuation Equipment**

No switch shall be interposed between a main switch and downstream switchboards supplying evacuation equipment.

**7.2.9 Emergency Lifts**

**7.2.9.1 General**

**7.2.9.1.1 In Australia [K]**

In Australia only, lifts deemed to be emergency lifts by the NCC are safety services. Although compliance with the AS 1735 series is not a requirement of this Standard, regulatory authorities may require compliance and may have additional requirements.

**7.2.9.1.2 In New Zealand [NZ]**

In New Zealand only, lifts required to operate for firefighting or other emergency purposes are safety services.

**7.2.9.2 Control and Protection**

Each lift or each group of lifts that is specifically required to operate for firefighting or other emergency purposes shall be controlled and protected independently of all other lifts. Main switches controlling lifts, arranged in accordance with Clause 7.2.4, shall be identified in accordance with the requirements of Clause 7.2.4.4 and distinguished from main switches controlling other lifts.

**7.2.9.3 Wiring Systems for Emergency Lifts**

**7.2.9.3.1 Types of Wiring System for Emergency Lifts**

Wiring systems supplying emergency lifts shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment (see Figure 7.1). **NOTE:** See Appendix H for further information regarding the application of the WS classification system.

Where the Australian, New Zealand or Australian/New Zealand Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and that is protected against mechanical damage by: (i) Installation in an effective enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

**Exceptions:** The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to the following:

1. Wiring systems in an enclosure or location that provides protection against fire and mechanical damage. **Example:** Wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.
2. Circuits supplying lifts beyond the terminals of a circuit-breaker provided in the lift machine room for the control and protection of the lift installation.

**7.2.9.3.2 Segregation of Cables**

Conductors supplying lifts shall not be enclosed with different safety services or with conductors of any other system. For the purposes of this Clause, the following applies: (a) If a duct or trunking is divided into separate channels by means of fixed and continuous barriers that provide effective segregation, each channel may be regarded as a separate enclosure. (b) Wiring systems complying with Clause 7.2.2 may be considered to provide effective segregation. (c) Conductors of different safety services shall not be incorporated with each other within a multi-core cable or be incorporated with conductors of any other wiring system within a multi-core cable.

**7.2.9.4 Interposing Switches**

No switch shall be interposed between a main switch for lifts and downstream lift switchboards. **Exceptions:** This requirement need not apply to the following:

1. Where an alternative supply system is provided in accordance with Clause 7.2.2.3.1.
2. To switches located remote from the building for which the safety services are provided, e.g., upstream switches supplying an outbuilding or fire-separated portion of a building.

**7.2.9.5 Switchgear**

Where emergency equipment is required by national building codes, all switchboards that sustain supply to such equipment shall be constructed so that the emergency equipment switchgear is separated from other switchgear by metal partitions designed to minimize the spread of a fault from the other switchgear to the emergency switchgear.

**7.2.10 Emergency Motor-Room-Less Lifts**

**7.2.10.1 General**

Lifts classified as motor-room-less lifts (MRLs) are lifts that due to their design have no need for a traditional lift motor room. An MRL switchboard shall comply with the requirements of Clause 2.10. MRLs that are: (a) fitted for the evacuation of persons in an emergency from a building; or (b) installed to facilitate the activities of the fire brigade and other emergency services personnel; or (c) designated emergency lifts in the design, shall comply with the additional installation requirements of this Clause. **NOTE:** Regulatory authorities may have additional requirements.

**7.2.10.2 Switchboards**

An MRL switchboard shall not be located in the lift shaft. A switchboard located remote from the main switchboard and dedicated to supplying individual MRL switchboards shall be readily accessible and enclosed in a fire-rated room or enclosure.

**7.2.10.3 Switchgear**

An MRL switchboard shall be located in a readily accessible position in accordance with Clause 2.10. An MRL switchboard that penetrates through into the lift shaft shall maintain the fire rating in accordance with Clause 3.9.9.3(a)(iii).

**7.2.10.4 Wiring Systems**

**7.2.10.4.1 Types of Wiring Systems for MRL Lifts**

Wiring systems supplying MRLs shall comply with AS/NZS 3013 with a WS classification as specified by the Standard relevant to the installation of such equipment (see Figure 7.1). **NOTE:** See Appendix H for further information regarding the application of the WS classification system.

Where the Australian, New Zealand, or Australian/New Zealand Standard does not specify a WS classification, the wiring system shall be of a type that is: (a) capable of maintaining supply to the equipment when exposed to either fire or mechanical damage; or (b) capable of maintaining supply to the equipment when exposed to fire and that is protected against mechanical damage by: (i) Installation in an effective enclosure; or (ii) installation in a location where the system will not be exposed to mechanical damage.

**Exception:** The fire and mechanical protection requirements specified in Items (a) and (b) above need not apply to wiring systems in an enclosure or location that provides protection against fire and mechanical damage. For example, wiring systems installed in underground locations, buried in concrete or masonry walls or floors, or installed in an appropriate fire-rated enclosure and provided with effective mechanical protection.

**7.2.10.4.2 Segregation of Cables**

Conductors supplying MRL lifts shall not be enclosed with different safety services or with conductors of any other system.

**7.3 Electricity Generation Systems**

**7.3.1 General**

The particular requirements of this Clause (Clause 7.3) supplement or amend the requirements of Sections 2 to 7 of this Standard for electricity generation systems connected to electrical installations that are intended to supply, either continuously or occasionally, all or part of the installation, including co-generation. An electricity generation system may consist of the following:

(a) **Alternative and supplementary supply**: A generator set, typically combustion engine-driven, that: (i) provides an alternative or stand-by a.c. electricity supply in the event of failure of the normal power supply to the installation; or (ii) is used as the primary power supply to an electrical installation; or (iii) is used as part of a stand-alone power system.

(b) **Stand-alone power system**: A system that is not connected to the power distribution system of a network provider. Stand-alone systems may be supplied with power from one or more of the following: (i) Photovoltaic array. (ii) Wind turbine or mini-hydro turbine. (iii) Engine-driven generator set in the form of an a.c. supply or a d.c. supply.

(c) **Inverter system**: An inverter system that provides an a.c. power supply from an interactive inverter using a renewable energy source, such as photovoltaic, wind turbine, or mini-hydro turbine. In the event of the renewable energy output available exceeding the electrical installation load, subject to formal approval of the electricity distributor, any surplus energy available is exported into the distribution system. If the output available from the renewable energy sources is insufficient for the installation loading, the shortfall in energy required is imported from the network. The interactive inverter of the system also provides control of the exporting and importing of energy from the system and network.

(d) **Battery system**: A battery system that provides supply from an alternative energy source, such as a generator set, photovoltaic array, wind turbine, or mini-hydro turbine, to charge a battery bank and provide a d.c. supply to an electrical installation.

**7.3.2 Selection and Installation of System**

The selection, installation, and control of electrical equipment that is intended to form an electricity generation system shall comply with the following Standards: (a) Engine-driven generating sets ........................................ AS/NZS 3010. (b) Stand-alone power systems ........... AS/NZS 4509 (series). (c) Battery systems ............................ AS 3011 (series) and AS/NZS 5139. (d) Photovoltaic array systems ............................................... AS/NZS 5033. (e) Inverter systems ............................................... AS/NZS 4777 (series).

**7.3.3 Control**

An electricity generation system shall be controlled by a main switch or switches at the installation switchboard to which the connection of the electricity generation system is made. The electricity generation system shall be controlled by switches or devices suitable for starting and stopping the electricity generation system. Where there is more than one switch or device for this purpose, they shall be grouped together and clearly identified.

An electricity generation system shall be so arranged that it cannot supply energy upstream of the point of connection to the installation either directly or indirectly. **Exception:** An electricity distributor may enter into a formal agreement to permit co-generation (feedback or exporting into the upstream network) under specific conditions. Examples include grid-connected inverter-based systems or engine-driven generating systems intended to operate in parallel with the network. **NOTE:** Conditions for the connection of grid-connected systems, co-generation, and other systems that are intended to operate in parallel with the electricity distributor's system are beyond the scope of this Standard.

**7.3.3.1 Basic Protection and Fault Protection**

Provision shall be made to ensure that all necessary connections for basic and fault protection in the installation, such as the MEN connection, remain intact when supply is available from the output of the electricity generation system.

**7.3.4 Isolation**

**7.3.4.1 General**

An inverter or regenerative supply source shall not be connected downstream of the generating set changeover device. **Exception:** This requirement need not apply where control systems prevent backfeed to the generator. Each electricity generation system shall be provided with an isolating switch, in accordance with Clause 2.3.2.2. The following applies: (a) The isolating switch shall be: (i) installed adjacent to, or on, the electricity generation system so that a person operating the switch has a clear view of any person working on the electricity generation system; or (ii) provided with a means of securing the device in the isolated position that requires a deliberate action to engage or disengage. and (b) The isolating switch may be combined with overcurrent protection required by Clause 7.3.5.1. and (c) The isolating switch shall comply with Clause 4.13 when the electricity generation system incorporates an electric motor. and (d) The isolating switch shall be under manual control only. and (e) The isolating switch shall not be capable of being overridden or bypassed by programmable control systems or the like. **Exception:** The requirements for isolation locations detailed in this Clause may be varied in other related Standards.

**7.3.4.2 Electricity Generation Systems Incorporating Batteries**

Where batteries are incorporated in an electricity generation system, a switch capable of interrupting the supply from such batteries shall be installed adjacent to the batteries and shall be clearly identified to indicate its purpose. A single switch that incorporates both a.c. and d.c. switching functions outlined in Clause 7.3.4.1 and this Clause (Clause 7.3.4.2) may be used.

**7.3.5 Overcurrent Protection**

**7.3.5.1 Electricity Generation System Protection**

Electricity generation systems shall be provided with overcurrent protection, in line with the applicable Australian, New Zealand, or Australian/New Zealand Standard for the particular generating system. Where the relevant Standard does not specify overcurrent requirements, then the following requirements apply: (a) Overcurrent protective devices shall be located as close as practicable to the output terminals of the electricity generation system so that the unprotected interconnecting conductors to an electrical installation are as short as practicable and, in no case, exceed 15 m in length. **Exception:** Overcurrent protective devices need not be provided where the unexpected interruption of the supply could cause a greater danger than overcurrent. (b) Any unprotected interconnecting conductors between the generating set and associated switchboard shall be completely enclosed by metal or other material that is not combustible or installed underground. **Exception:** Overcurrent protection may be provided by:

1. an overcurrent protective device within the electricity generation system; or
2. the characteristics of the electricity generation system being unable to support the fault current.

Where a single electricity generation system is intended to operate in parallel with another electricity generation system, circulating harmonic currents shall be limited so that the current carrying capacity of conductors is not exceeded. **NOTE:** The effects of circulating harmonic currents may be limited as follows: (a) The selection of generating sets with compensated windings. (b) The provision of a suitable impedance in the connection to generator star points. (c) The provision of switches that interrupt the circulatory circuit but that are interlocked so that at all times fault protection is not impaired. (d) The provision of filtering equipment. (e) Other effective means.

**7.3.5.2 Circuit Protection**

**7.3.5.2.1 General**

The prospective short-circuit current and prospective earth fault current shall be assessed for each electricity generation system or combination of systems that can operate to supply an installation. The short-circuit rating of protective devices within the electrical installation shall not be exceeded for any of the intended methods of operation of the electricity generation system. **NOTE:** If the electricity generation system has an electronic overcurrent protection system fitted, e.g., inverters, such devices may automatically limit the output current and may prevent the operation of an external overcurrent device within the installation under fault conditions. Every circuit outgoing from an electricity generation system shall be individually protected in accordance with Clause 2.5 and shall also include additional (earth leakage) protection where required by Clause 2.6. A circuit is considered to be protected against prospective short-circuit and earth fault currents when it is supplied from an electricity generation system incapable of delivering a current exceeding the current-carrying capacity of the circuit. **NOTE:** Typical supply sources include small generating sets or inverters fitted with electronic overload protection systems. **Exception:** Overcurrent protective devices shall not be provided where the unexpected interruption of the supply could cause a greater danger than overcurrent.

**7.3.5.2.2 RCDs**

The possible waveform of a fault current to earth can affect the operation of RCDs and shall be taken into account for the selection of the type of RCD. Where an electricity generation system includes an inverter, the RCD shall be of a type suitable for the earth fault waveform of the particular inverter, and in accordance with the inverter manufacturer's instructions. **NOTE:** Requirements for types of RCDs are set out in Clause 2.6.2.2.

**7.3.6 Earthing**

The system of protective earthing in the electrical installation shall be a MEN system in accordance with Section 5. **Exception:** Where the output of the electricity generation system does not exceed 25 kVA, the output may be arranged as a separated supply, in accordance with the requirements of Clause 7.4. Any exposed conductive parts of the electricity generation system shall be earthed by connection to the main earthing conductor at the main switchboard.

**7.3.7 Connected Electrical Equipment**

Any accessory, conductor, insulation, or other component connected to the output side of an electricity generation system shall be suitable for the voltage, current, and frequency of the output of the system. **NOTE:** The values of current-carrying capacity and voltage drop specified in the AS/NZS 3008.1 series are based on 50 Hz a.c. conditions but may also be applied to d.c. installations to provide conservative results.

**7.3.8 Connection to Electrical Installation**

**7.3.8.1 Alternative Supplies**

**7.3.8.1.1 General**

The following shall apply to the connection of an alternative (stand-by) supply to an installation: (a) The incoming neutral to a MEN switchboard shall not be switched. (b) The neutral-earth connection (MEN connection) shall be made within the installation at the main switchboard. This may require disconnection of any neutral-earth connection within an electricity generation system, such as an engine-driven generating set. This requirement applies to any switchboard fitted with an MEN connection and may be the main switchboard or a switchboard in an outbuilding, regarded as a main switchboard for earthing purposes within the outbuilding. (c) Neutral and earth conductors shall not operate in parallel. **Exception:**

1. In Australia only, when connected to a distribution switchboard and operating on the alternative supply, the distribution board submain neutral and protective earthing conductors may be operated in parallel through a remote MEN connection within the installation provided that:
   * conductors are not overloaded by current sharing;
   * conductors are suitable for the maximum calculated fault current;
   * the nominal size of copper earthing conductors complies with the requirements of Clause 5.3.3; and
   * the current-carrying capacity of neutral conductors shall be not less than that of their associated active conductor.
2. In New Zealand only, where the generating set is connected to a switchboard without a N-E link and when the electrical installation is operating from the alternative supply, a N-E connection and a connection to the mass of earth are required to be made in the distribution switchboard in accordance with AS/NZS 3010. This N-E connection and connection to the mass of earth are not required when the electrical installation is operating from a normal supply.

**7.3.8.1.2 Switching**

The changeover device for an alternative supply shall be selected to maintain the function of, and prevent damage to, the electrical installation being supplied. Functions to be maintained include the maintenance of the continuity of the neutral conductor (overlapping of neutrals), the operation of RCDs, or the continued operation of uninterruptible power supplies. The changeover device shall open all active conductors of the normal supply when the alternative supply is connected. Where the operation of a switch automatically brings into service an alternative supply, the purpose of the switch shall be marked accordingly. Switching arrangements in accordance with AS/NZS 3010 are deemed to satisfy these requirements. **NOTE:** Typical switching arrangements are shown in Figures 7.3, 7.4, 7.5, and 7.6.

**7.3.8.2 Grid-Connected Inverter Systems**

**7.3.8.2.1 General**

The connection of a grid-connected system is subject to formal agreement with the electricity distributor.

**7.3.8.2.2 Switching**

A main switch shall be provided to enable isolation of the inverter output from the switchboard to which it is connected. All switches shall be clearly identified as to their function, in accordance with Clause 2.3.2.

**7.3.8.2.3 Connection**

The method of connection of a grid-connected inverter system shall be in accordance with the AS/NZS 4777 series of Standards in conjunction with the requirements of the electricity distributor. The electricity generation system shall not impose a voltage on the electrical installation measured at the point of supply between the electricity distributor's network and the electrical installation outside the limits specified by Clause 1.6.2(c). **NOTE:** A typical interactive inverter a.c. connection and main switch (solar supply) is shown in Figure 7.7.

**7.3.8.3 Stand-Alone Power Systems**

**7.3.8.3.1 General**

The consumer mains of the electrical installation shall be connected to the output of the electricity generating system.

**7.3.8.3.2 Switching**

Control of the electrical installation shall be arranged in accordance with Clause 2.3.

**7.3.8.3.3 Connection**

The method of connection of a stand-alone system shall be in accordance with the AS/NZS 4509 series of Standards. **NOTE:** A typical stand-alone connection is shown in Figure 7.4 for an installation with a switchboard including a local MEN connection.

**7.4 Protection by Electrical Separation (Isolated Supply)**

**NOTE:** The expression 'electrical separation' has the same meaning as 'isolated supply'. 'Electrical separation' is used throughout this Clause.

**7.4.1 General**

The particular requirements of this Clause (Clause 7.4) provide methods of protection against electric shock arising from indirect contact that are deemed to comply with Clause 1.5.5.5. These methods include that of protection by electrical separation of the supply. Protection by electrical separation is an alternative to other recognized methods and is intended, in an individual circuit, to prevent shock current through contact with exposed conductive parts that might be energized by a fault in the basic insulation of that circuit. Protection by electrical separation shall be afforded by compliance with Clauses 7.4.2 to 7.4.4, and with: (a) Clause 7.4.5 for a supply to one item of equipment; or (b) Clause 7.4.6 for a supply to more than one item of equipment. **NOTE:** Figure 7.6 provides an illustration of a separated supply to single and multiple items of equipment.

**7.4.2 Source of Supply**

The source supplying a separated circuit shall be: (a) An isolating transformer complying with AS/NZS 61558 so that the output is separated from the input by double insulation or equivalent. **NOTE:** The scope of AS/NZS 61558.1 incorporates isolating transformer ratings up to 25 kVA for single-phase and 40 kVA for multiphase. The use of higher ratings is permitted provided that the relevant construction and verification provisions of AS/NZS 61558 are applied. (b) A generator output, e.g., a motor-generator set that is installed so that the output is separated from the frame of the generator. **NOTE:** The fitting of an RCD and the connection of an equipotential bonding conductor and an additional conductor to the generator output winding to ensure the correct operation of the RCD, does NOT provide the output separation required by this Clause. See AS/NZS 3010 for details. (c) An isolated inverter complying with the safety requirements of AS/NZS 4763. **NOTE:** The rated output for separated (isolated) transformers or generators should be limited to 25 kVA for single-phase and 40 kVA for poly-phase supplies to ensure stable operation.

**7.4.3 Arrangement of Circuits**

Separated circuits shall comply with the following requirements: (a) Circuit voltage shall not exceed 500 V. (b) All live parts of a separated circuit shall be reliably and effectively electrically separated from all other circuits, including other separated circuits and earth. This requirement shall also apply to live parts of relays, contactors, and similar electrical equipment installed in the separated circuit. **NOTES:**

1. This requirement can be satisfied by insulation of the live parts to Class II (double or reinforced insulation) or measures that are equivalent to the input and output transformer winding isolation provisions of AS/NZS 61558.
2. Each separated circuit should comprise a separate cable or wiring system. However, multi-core cables or a common non-conductive wiring enclosure may be used where the segregation requirements of Clause 3.9.8 are satisfied. (c) Exposed conductive parts of electrical equipment supplied by a separated circuit shall not be connected to the protective earthing conductor, or the exposed conductive parts, of the source of supply. (d) Cables and supply flexible cords to electrical equipment shall be protected against mechanical damage or otherwise arranged to ensure that any damage that might occur is readily visible.

**7.4.4 Switching Devices**

Switching devices shall operate in all live conductors of a separated circuit. **NOTE:** Switching the active conductor(s) of the primary of an isolating transformer, in accordance with Clause 2.3.2, is an acceptable method of control and disconnection of supply.

**7.4.5 Supply to Single Item of Electrical Equipment**

Where a separated circuit supplies a single item of electrical equipment, any exposed conductive parts of the electrical equipment shall not be connected to the exposed conductive parts of any other circuit, including other separated circuits or earth.

**7.4.6 Supply to Multiple Items of Electrical Equipment**

Where a separated circuit supplies more than one item of electrical equipment, the following requirements apply: (a) Any exposed conductive parts of the separated circuit shall be connected together by an insulated equipotential bonding conductor that is not connected to: (i) earth; (ii) a protective earthing conductor or exposed conductive parts of another circuit, including another separated circuit; or (iii) any extraneous conductive parts. (b) The designated earthing contact of any socket-outlet installed on the separated circuit shall be connected to the equipotential bonding conductor. (c) The designated protective earthing conductor in any supply cable or flexible cord to electrical equipment [other than Class II (double or reinforced insulation) equipment] connected to the separated circuit shall be connected to the equipotential bonding conductor. (d) Exposed conductive parts of the source of supply that are earthed shall not be simultaneously accessible with any exposed conductive part of the separated circuit. (e) A protective device shall operate to disconnect the separated circuit automatically in the event of two faults resulting in exposed conductive parts being connected to live parts of different polarity. If the protective device is a circuit-breaker, the protective device shall open in all unearthed conductors substantially together.

**7.4.7 Variable Speed Drive (VSD) EMI Filters**

Where a variable speed drive uses an EMI filter it shall not reference the frame of the system. Optimally, only one EMI filter should be used on an isolated supply where multiple VSDs are used. **NOTE:** EMI filters referenced to the frame produce harmful capacitive coupled currents.

**7.4.8 Testing**

**7.4.8.1 General**

In addition to the testing requirements of Section 8, the separation of each separated circuit (transformer secondary winding or isolated winding generator output) and the wiring to the socket-outlet shall be individually confirmed. Separation shall be verified by a measurement of the insulation resistance between the separated circuit and: (a) if a transformer is the source of the separated supply, the transformer primary winding; (b) any other wiring; (c) any other separated circuit; and (d) earth. Insulation resistance values obtained shall be not less than 1 MΩ, when tested at a voltage of 500 V d.c. **NOTE:** Where final subcircuits are not of significant length, the insulation resistance of the separated circuit should be significantly greater than 1 MΩ, e.g., with short lengths (say 50 m) of polymeric cable, a value in excess of 50 MΩ would be expected.

**7.4.8.2 Single Items of Electrical Equipment**

Where a single item of electrical equipment is supplied from a single separated circuit, separation shall be verified in accordance with Clause 7.4.8.1 and, in addition, by a measurement of the insulation resistance between earth and: (a) exposed conductive parts; or (b) the earth contact of a socket-outlet.

**7.4.8.3 Multiple Items of Electrical Equipment**

Where more than one item of electrical equipment is supplied from a single separated circuit, separation shall be verified in accordance with Clause 7.4.8.1 and, in addition, by a measurement of the insulation resistance between: (a) the separated circuit and the equipotential bonding conductor; and (b) the equipotential bonding conductor and earth; and (c) the equipotential bonding conductor and any equipotential bonding conductor associated with another separated circuit.

**7.4.8.4 Bonding Conductor Continuity**

The resistance of an equipotential bonding conductor for the earth contacts of socket-outlets, or exposed conductive parts connected to the same separated circuit, shall not exceed 0.5 Ω.

**7.5 Extra-Low Voltage Electrical Installations**

**7.5.1 Scope**

The particular requirements of this Clause (Clause 7.5) apply to electrical installations or parts of electrical installations operating at extra-low voltage and are deemed to comply with Clause 1.5.7 for both basic and fault protection (protection against both direct contact and indirect contact) by the use of extra-low voltage.

**7.5.2 Application**

Extra-low voltage electrical installations shall be one of the following systems: (a) SELV; or (b) PELV. The particular requirements of this Clause (Clause 7.5) supplement, replace, or modify requirements of other Sections of this Standard. Where no particular requirement is specified in this Clause, extra-low voltage electrical installations shall comply with the relevant requirements of other Sections of this Standard. Where an electrical installation operates at extra-low voltage but does not comply with the SELV or PELV requirements of this Clause (Clause 7.5), it is deemed to be operating at low voltage and shall comply with the relevant requirements of other Sections of this Standard.

**7.5.3 Sources of Supply to SELV and PELV Systems**

The source supplying a SELV or PELV system shall be one of the following: (a) A safety isolating transformer complying with AS/NZS 61558. (b) A source of current independent of a higher voltage supply, such as an engine-driven generator, or an electrochemical source, such as a battery. (c) A source of current separated from higher voltage electrical installations, such as a motor-generator set, with electrically separate windings having a degree of electrical separation equivalent to that specified by Item (a). (d) Certain electronic devices complying with appropriate Standards, where, in the case of an internal fault, the voltage at the output terminals cannot exceed extra-low voltage. Higher voltages at the output terminals may be used, provided that the voltage at the output terminals is immediately reduced to extra-low voltage if contact is made with live parts under normal or fault conditions.

**NOTE:** Such devices include insulation testing equipment.

**7.5.4 Separation Requirements for SELV and PELV Circuits**

Live parts of SELV and PELV circuits shall be electrically separated from each other and from other higher voltage circuits. Arrangements shall ensure a level of electrical separation equivalent to that between the input and output of a safety isolating transformer complying with AS/NZS 61558. SELV and PELV circuit conductors shall be segregated from those of other circuit conductors.

**Exception:** SELV and PELV circuit conductors installed in accordance with Clause 3.9.8.3 may be contained within the same wiring system as low voltage circuits. Live parts shall be arranged so that short-circuit or arcing, either between live parts or between live parts and other conductive material, will not take place under the conditions that may reasonably be expected in service.

**7.5.5 Arrangement of SELV Circuits**

Live parts of SELV circuits shall not be connected to earth or protective earthing conductors that are part of other circuits or to other live parts. SELV circuits shall not be connected to: (a) Other circuits; (b) Earth; (c) Earthing conductors or exposed conductive parts of another system; or (d) Extraneous conductive parts.

**Exception:** Connection to extraneous conductive parts may be made where electrical equipment is inherently required to be so connected and it is ensured that the extraneous conductive parts cannot attain a voltage exceeding that of the SELV circuit.

**NOTE:** If SELV circuits are liable to come into contact, either fortuitously or intentionally, with the exposed conductive parts of other circuits, protection against electric shock no longer depends solely on protection by SELV but on the protective measure to which the latter exposed conductive parts are subject. Where the nominal voltage exceeds 25 V a.c. or 60 V ripple-free d.c., protection against electric shock in normal service (direct contact) shall be provided by: (i) Barriers or enclosures with a degree of protection of at least IPXXB or IP2X; or (ii) Insulation capable of withstanding a test voltage of 500 V a.c. for 1 min.

**NOTES:**

1. Basic protection is not necessary for voltages not exceeding 25 V a.c. or 60 V ripple-free d.c., in dry indoor conditions.
2. Insulation is capable of withstanding the test voltage for the required period when the insulation resistance after the test voltage has been applied for the specified period remains above the required minimum value.

**7.5.6 Arrangement of PELV Circuits**

The following applies for PELV circuits, where one conductor of the output circuit is earthed: Basic protection shall be provided by: (a) Barriers or enclosures affording a degree of protection of at least IPXXB or IP2X; or (b) Insulation capable of withstanding a test voltage of 500 V a.c. for 1 min.

**Exception:** Basic protection shall be deemed unnecessary if electrical equipment is within the zone of influence of equipotential bonding and the nominal voltage does not exceed:

1. 25 V a.c. or 60 V ripple-free d.c., when electrical equipment is normally used in a dry location only and large-area contact with the human body is not to be expected; or
2. 6 V a.c. or 15 V ripple-free d.c., in all other cases.

**NOTES:**

1. The earthing of circuits may be achieved by an appropriate connection to earth within the source itself.
2. AS/NZS 60479 indicates that large-area contact is approximately 8000 mm².
3. Insulation is capable of withstanding the test voltage for the required period when the insulation resistance, after the test voltage has been applied for the specified period, remains above the required minimum value.

**7.5.7 Voltage Drop in Conductors**

The drop in voltage at any point in an extra-low voltage electrical installation shall not exceed 10% of the nominal value when all live conductors are carrying the circuit-operating current.

**NOTE:** Information on voltage drop is given in the AS/NZS 3008.1 series.

**Exception:** This requirement need not apply where electrical equipment is specially designed for operation with a voltage drop greater than 10%.

**NOTE:** Motor starting, solenoid closing and other similar applications where high transient currents may be experienced that can significantly increase voltage drop are excluded from consideration.

**7.5.8 Control of an Electrical Installation**

**7.5.8.1 Main Switches**

The supply to an extra-low voltage electrical installation shall be controlled by a main switch or switches operating in all unearthed conductors.

**Exception:** This requirement need not apply where the extra-low voltage electrical installation is supplied from part of an electrical installation operating at a voltage greater than extra-low voltage and the operation of the main switch for the high voltage part of the electrical installation results in the disconnection of the supply.

**7.5.8.2 Other Switches**

Switches in an extra-low voltage electrical installation shall comply with the following: (a) A switch shall operate in all unearthed conductors where the extra-low voltage supply is earthed at the point of supply, e.g., PELV. (b) Switches may operate in one less conductor than the number of conductors in the circuit, e.g., SELV

**7.5.9 Overcurrent Protection**

**7.5.9.1 General**

Every extra-low voltage circuit shall be individually protected at its origin against overload and short-circuit currents by a protective device that: (a) Shall comply with the applicable requirements of Clauses 2.2 and 2.5. (b) May be provided in one conductor less than the number of conductors in the circuit.

Where the extra-low voltage supply is earthed at the point of supply, the protective devices shall be installed in all the unearthed conductors.

**Exception:** Circuits arranged in accordance with Clause 7.5.9.2 need not be provided with overcurrent protection.

**7.5.9.2 Omission of Overcurrent Protection**

Overcurrent protection need not be provided where one of the following applies: (a) The expected interruption to supply could result in a greater danger than the overcurrent. (b) The rated output of the source of supply does not exceed the current rating of the circuit and the circuit is supplied from either of the following sources: (i) A transformer marked to indicate that it is short-circuit proof in accordance with AS/NZS 61558 and: (A) The rated output of the transformer does not exceed 1 A; or (B) The short-circuit current of the transformer does not exceed the current-carrying capacity of the circuit conductors and such short-circuit current is marked on the transformer. (ii) A battery, comprising cells having a high internal resistance, e.g., Leclanche or dry-type primary cells.

**7.5.10 Connecting Devices**

Plug and socket-outlet devices, including installation couplers, for SELV and PELV shall comply with the following: (a) Plugs shall not be able to enter sockets of other voltage systems. (b) Sockets shall not accept plugs of other voltage systems. (c) Sockets shall not have a contact for a protective earthing conductor.

**7.5.11 Wiring Systems**

**7.5.11.1 General**

Conductors and insulation of cables for extra-low voltage electrical installations shall be suitable for the intended purpose and need not be further protected unless installation conditions so demand.

**NOTE:** Attention is drawn to the requirements of Clause 3.9.8.3 for segregation of different wiring systems and the need for further protection in some situations.

**7.5.11.2 Aerial Conductors**

Aerial conductors used in extra-low voltage electrical installations shall be installed in accordance with the applicable requirements of Clause 3.12.

**Exceptions:**

1. The clearances above ground or elevated areas need not apply provided that the requirements of Clause 3.3.1 are satisfied.
2. Bare conductors may be erected in accordance with the requirements for insulated conductors.

**7.5.11.3 Underground Conductors**

There are no depth-of-burial requirements for the safety of extra-low voltage cables.

**NOTE:** Consideration should be given to the risk of mechanical damage.

**7.5.12 Testing**

**7.5.12.1 General**

The separation of ELV circuits shall be verified in accordance with Clause 7.5.12.2 in the case of protection by SELV, and Clause 7.5.12.3 in the case of protection by PELV. The insulation resistance value obtained in accordance with Clauses 7.5.12.2 and 7.5.12.3 shall not be less than 0.5 MΩ when tested at a voltage of 250 V d.c.

**7.5.12.2 Protection by SELV**

The separation of live parts from those of other circuits and from earth shall be confirmed by a measurement of the insulation resistance.

**7.5.12.3 Protection by PELV**

The separation of live parts from other circuits shall be confirmed by a measurement of the insulation resistance.

**7.6 High Voltage Electrical Installations**

**7.6.1 Scope**

The particular requirements of this Clause (Clause 7.6) apply to electrical installations and those portions of electrical installations operating at high voltage. For protection and earthing purposes, this Clause also applies to all the electrical equipment up to and including any low voltage cables and switchgear associated with high voltage transformers.

This Clause (Clause 7.6) does not apply to the following: (a) Electric discharge illumination systems. (b) X-ray equipment. (c) High frequency equipment. (d) High voltage wiring and electrical equipment enclosed within self-contained electrical equipment and supplied at low voltage where precautions have been taken to prevent contact with high voltage conductors.

**7.6.2 Application**

**7.6.2.1 In Australia**

In Australia, electrical installations and those portions of electrical installations operating at high voltage shall be installed in accordance with AS 2067.

**7.6.2.2 In New Zealand**

In New Zealand, requirements for high voltage electrical installations and those portions of electrical installations operating at high voltage are set in the Electricity (Safety) Regulations.

**7.6.3 Issues Relevant to High Voltage Installations**

For the design of electrical installations with voltage 1 kV or more, the issues that shall be taken into account include the following: (a) Insulation levels to withstand highest voltage and/or impulse withstand voltages. (b) Minimum clearances to live parts taking into account electrode configurations and impulse withstand voltages. (c) Minimum clearances under special conditions. (d) The application of various devices connected to the system. (e) The methods of installation of equipment, cables and accessories. (f) General requirements of installations regarding choice of circuit arrangement, documentation, transport routes, lighting, operational safety and labelling. (g) Special requirements with respect to buildings. (h) Protection measures with respect to access. (i) Protection measures with respect to fire. (j) Provision of earthing such that the system operates under all conditions and ensures safety of human life where there is legitimate access. (k) Testing.

**7.7 Hazardous Areas (Explosive Gas or Combustible Dusts)**

**7.7.1 Scope**

The particular requirements of this Clause (Clause 7.7) apply to the selection of electrical equipment and its installation to ensure safe use in areas where flammable or combustible materials are produced, prepared, processed, handled, stored or otherwise exist, and therefore may give rise to an explosive atmosphere.

**7.7.2 Classification of Hazardous Areas**

**7.7.2.1 Responsibility for Classification**

The responsibility for classification of a hazardous area (see Clause 1.4.15) rests with the persons or parties in control of the installation. The requirements are contained in AS/NZS 60079.10.1 for gas or vapour and AS/NZS 60079.10.2 for combustible dust.

**7.7.2.2 Hazardous Areas (AS/NZS 60079 Series)**

For the purposes of classification, two types of hazardous area are as follows: (a) Hazardous area (gas or vapour) in which an explosive gas atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus.

**NOTES:**

1. Hazardous areas are divided into zones based upon the frequency and duration of the occurrence of explosive gas atmospheres.
2. Explosive gas atmospheres include flammable vapours (from liquids).

(b) Hazardous area (dust) in which combustible dust in the form of a cloud is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

**NOTES:**

1. Hazardous areas are divided into zones based upon the frequency and duration of the occurrence of explosive dust atmospheres.
2. The potential of creating an explosive dust cloud from a dust layer.
3. Combustible dusts may include fibres and flyings.

**7.7.2.3 Reduction or Elimination of the Hazard**

Through design and operation, it is possible to reduce the degree of hazard. This is achieved by giving attention to items such as plant layout, product containment and ventilation.

**7.7.2.4 Electrical Equipment**

**7.7.2.4.1 Selection**

Electrical equipment selected for use in hazardous areas shall comply with the applicable requirements of AS/NZS 60079.14.

**7.7.2.4.2 Installation**

Electrical equipment shall be installed in accordance with the installation requirements of AS/NZS 60079.14.

**NOTES:**

1. AS/NZS 60079.14 includes requirements for the competency of persons.
2. AS/NZS 60079.17 includes requirements for inspection and maintenance.

**7.8 Standards for Specific Electrical Installations**

**7.8.1 Scope**

This Clause (Clause 7.8) specifies Standards for specific electrical installations. Where the listed Standards do not specify a requirement, the relevant requirements of this Standard appl

**7.8 Standards for Specific Electrical Installations**

**7.8.2 Standards Containing Requirements that are Additional to, Replace, or Modify the General Requirements of this Standard**

**7.8.2.1 Construction and Demolition Sites** Electrical installations for construction and demolition sites shall comply with AS/NZS 3012.

**7.8.2.2 Electromedical Treatment Areas** Electrical installations in electromedical treatment areas (including home patient areas) shall comply with AS/NZS 3003.

**7.8.2.3 Transportable Structures and Vehicles Including Their Site Supplies** Electrical installations in transportable structures and vehicles, including their site supplies, shall comply with AS/NZS 3001.

**7.8.2.4 Marinas and Recreational Boats** Electrical installations in marinas and recreational boats shall comply with AS/NZS 3004.

* **Note 1:** AS/NZS 3004 is a two-part standard as follows:
  + (a) AS/NZS 3004.1 provides requirements for electrical installations on marinas.
  + (b) AS/NZS 3004.2 provides requirements for electrical installations in recreational boats.
* **Note 2:** In Australia, for electrical installations on commercial vessels, refer to the Australian Maritime Safety Authority, National Marine Safety Committee's National Standard for Commercial Vessels, Part C: Design and construction—Section 5: Engineering—Subsection 5B: Electrical (NSCV C5B).

**7.8.2.5 Shows and Carnivals** Electrical installations in shows and carnivals shall comply with AS/NZS 3002.

**7.8.2.6 Telecommunication Network Power Supplies** Extra-low voltage (d.c.) power supply installations within public telecommunication networks shall comply with AS/NZS 3015.

**7.8.2.7 Cranes and Hoists** Electrical installations for cranes and hoists shall be in accordance with the applicable requirements of this Standard.

* **Note:** Such electrical installations may be subject to the requirements of the AS 1418 series or other requirements of the relevant regulatory authorities.

**7.8.2.8 Lifts** Electrical installations for lifts shall be in accordance with the applicable requirements of this Standard.

* **Notes:**
  1. See Clause 7.2.3.4 for requirements affecting the control and arrangement of special lift installations.
  2. Such electrical installations are within the scope of the AS 1735 series and compliance therewith may be required by the relevant regulatory authorities.

**7.8.2.9 High Voltage Installations**

* In Australia, high voltage electrical installations shall comply with AS 2067.
* In New Zealand, high voltage installations shall comply with the New Zealand Electricity (Safety) Regulations.

**7.8.2.10 Generating Sets** Electrical installations which include the use of generating sets for the supply of electricity at voltages normally exceeding 50 V a.c. or 120 V d.c. shall comply with AS/NZS 3010.

**7.8.2.11 Inverters** Electrical installations including grid connections of energy systems via inverters shall comply with AS/NZS 4777 series.

**7.8.2.12 (Text Deleted)**

**7.8.2.13 Stand-Alone Power Systems** Electrical installations including stand-alone power systems shall comply with AS/NZS 4509 series.

**7.8.2.14 Photovoltaic (PV) Arrays** Electrical installations including photovoltaic arrays shall comply with AS/NZS 5033.

**7.8.2.15 Secondary Battery Systems** Battery energy storage systems (BESS) and associated battery systems, as defined in AS/NZS 5139, shall comply with AS/NZS 5139. All other secondary battery systems, as defined in the scope of AS 3011 (series), installed in buildings, structures, or premises such as those with critical power continuity requirements (e.g., for telecommunications, uninterruptible power supplies (UPS), hospitals, sub-stations, and black start) that are outside the scope of AS/NZS 5139 shall comply with AS 3011 (series).

**7.8.2.16 Mobile Medical Facilities**

* In New Zealand, electrical installations for mobile medical facilities shall comply with NZS 6115.

**7.8.2.17 Floor and Ceiling Heating Systems**

* In New Zealand, electrical installations for floor and heating systems shall comply with NZS 6110.

**7.8.2.18 Explosive Atmospheres and Hazardous Areas** Electrical installations located in explosive atmospheres/hazardous areas that comply with AS/NZS 60079.14 are deemed to comply with this Standard.

**7.8.3 Standards Containing Guidance**

**7.8.3.1 Outdoor Sites Under Heavy Conditions** Electrical installations in outdoor sites where heavy conditions exist may require compliance with additional requirements. Such sites include open-cast mines, quarries, stockpiles, and other industrial areas exposed to particularly onerous environmental and operational conditions.

* **Note:** Such electrical installations are within the scope of AS/NZS 3007. Compliance with AS/NZS 3007, although not a requirement of this Standard, may be required by relevant regulatory authorities, who may also have other requirements.

**7.8.3.2 Electric Fences** Guidance on the installation requirements for electric fences is given in AS/NZS 3014 and AS/NZS 3016. Where an electrically operated fence is connected directly or indirectly to electricity supply mains, such connections shall be made only through a mains-operated fence controller complying with AS/NZS 60335.2.76.

**7.8.3.3 Emergency Power for Supply in Hospitals** Guidance on the installation requirements for emergency power supplies for hospitals is given in AS/NZS 3009.

**7.8.3.4 Lightning Protection** Guidance on the installation requirements for lightning protection systems is given in AS/NZS 1768.

**7.8.3.5 Uninterruptible Power Systems (UPS)** Guidance on the installation requirements for uninterruptible power systems is given in AS 62040 series.

**7.8.3.6 Semiconductor Power Converters** Guidance on the installation requirements for semiconductor power converters is given in AS 60146 series.

**7.8.3.7 Rotating Electrical Machines** Guidance on the installation requirements for rotating electrical machines is given in AS 60034 series.

**7.8.3.8 Periodic Verification** Guidance on periodic verification of electrical installations is given in AS/NZS 3019.

**7.8.3.9 Verification Guidelines** Verification guidelines for common tests that may be used to check whether low voltage installations comply with this Standard are given in AS/NZS 3017.

**7.8.3.10 Film, Video, and Television Sites** Guidance on the safe working procedures for the use of electrical equipment and electrical installations on film, video, and television sites is given in AS/NZS 4249.

* **Note:** Compliance with AS/NZS 4249 or other requirements, although not a requirement of this Standard, may be required by relevant regulatory authorities.

**7.9 Supplies for Electric Vehicles (NZ Only)**

**7.9.1 Scope** The particular requirements of this Clause (Clause 7.9) supplement or amend the requirements of Sections 2 to 7 of this Standard for parts of electrical installations intended for the charging of electric vehicles for New Zealand only.

* **Notes:**
  1. Appendix P contains information on the modes of charging used for charging systems used for electric vehicles.
  2. Attention is drawn to the contribution of EV charging to the maximum demand of an installation. Refer to Tables C1 and C2.
  3. Electricity distributors may require notification of the installation of EV charging equipment.

**7.9.2 Supply (NZ Only)**

**7.9.2.1 Source of Supply** The supply shall not be obtained from a switchboard in an outbuilding that has a separate MEN earthing system in accordance with Clause 5.5.3.1 option (c).

**7.9.2.2 Socket-Outlets for Mode 1 Charging** Socket-outlets shall not be installed for use for Mode 1 charging.

**7.9.3 Domestic Electrical Installations (NZ Only)**

**7.9.3.1 Facilities for Other than Mode 1 Charging** Every new domestic electrical installation that has a garage, being a fully enclosed space including a door that is used for accommodating a motor vehicle that is incorporated as part of the main dwelling structure, shall have a facility to enable electric vehicle charging in accordance with either Clause 7.9.3.2 or Clause 7.9.3.3.

**7.9 Supplies for Electric Vehicles (NZ Only)**

**7.9.3 Domestic Electrical Installations (NZ Only)**

**7.9.3.2 Facilities for Mode 2 Charging** Each facility for Mode 2 charging shall comply with all of the following: (a) The final subcircuit shall have a minimum current-carrying capacity of 20 A and shall not supply any other socket-outlet or point in wiring. (b) The socket-outlet shall comply with one of the following Standards and shall not be switched by the insertion or withdrawal of a plug:

* (i) AS/NZS 3112.
* (ii) IEC 60309-2.
* (iii) AS/NZS 3123.
* (iv) BS 1363-2. (c) The socket-outlet shall be installed at a minimum height of 800 mm from the floor or ground.

**7.9.3.3 Facilities for Mode 3 and 4 Charging** The supply for Mode 3 and 4 electric vehicle charging systems shall comply with all of the following: (a) Single-phase final subcircuits shall have a minimum current-carrying capacity of 32 A.

* **Note:** Where electric vehicle charging equipment that is greater than 20 A single phase is installed, consideration should be given to upgrading mains and/or the installation of a load management device to ensure continuity of supply and avoid excessive voltage drop. (b) The final subcircuit shall not supply any other point in wiring. (c) The final subcircuit shall be protected by a separate residual current device (RCD) of Type B complying with IEC 62423, with a maximum rated residual current of 30 mA which operates in all live (active and neutral) conductors. Combined RCD and overcurrent circuit-breakers (RCBOs) may be used.
* **Exception:** For Mode 3 charging facilities, a Type A RCD with a maximum rated residual current of 30 mA, in conjunction with a residual direct current-detecting device (RDC-DD) conforming to IEC 62955 may be used.
* **Note:** The RDC-DD disconnects supply where residual d.c. currents of 6 mA or greater are detected. (d) The charging equipment shall be connected by direct connection in accordance with Clause 4.3.2.1. (e) An isolating switch complying with Clause 2.3.2.2.1, with a minimum current rating of 32 A, shall be provided for the final subcircuit adjacent to the charging facility. (f) The socket-outlet or cable of the charging equipment shall be installed at a minimum height of 800 mm from the floor or ground.

**7.9.4 Other Electrical Installations (NZ Only)**

The final subcircuit shall be protected by a separate residual current device (RCD) of Type B complying with IEC 62423, with a maximum rated residual current of 30 mA which operates in all live (active and neutral) conductors. Combined RCD and overcurrent circuit-breakers (RCBOs) may be used.

* **Exception:** For Mode 3 charging facilities, a Type A RCD with a maximum rated residual current of 30 mA, in conjunction with a residual direct current-detecting device (RDC-DD) conforming to IEC 62955 may be used.
* **Note:** The RDC-DD disconnects supply where residual d.c. currents of 6 mA or greater are detected.